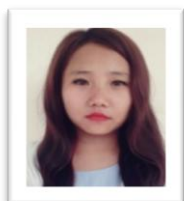


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Edible Insects of Nagaland and Its Nutritional Benefit



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Abstract

The food processed and prepared traditionally by its people is connected to their socio-culture life and health. The ways they cook not only demonstrate the creativity and treasure of food whole. Looking at the diversities on foods eaten by the people of Nagaland, an attempt was made to explore the ethnic food of Naga people and their medicinal, ecological and nutritional value. It was observed that the various traditional methods used by the tribal people to cook food plays a vital role in retaining the nutritive value of the food and has significant impact on their health (Bhardwaj Sushma, 2014-15). The Bazar in Dimapur is very dear to tribal people for the array of animals, insects and worms sold here. This study is an attempt to connect health, longevity and immunity to the people with the food they eat.

Edible insects constitute a very important food source in many developing good countries. They are good source of high content of proteins, fats, carbohydrates, minerals and vitamins (Ashiru 1988, De Foliart 1989, 1992). Insects play a key role in energy flow through the ecosystem, principally as herbivores but also as predators or parasites, which may themselves be consumed by higher-level insectivorous vertebrates. In turn, some of these vertebrates, notably freshwater fish and game birds, are eaten by humans. More than 200 genus and 70 families of insects are eaten up by people from different corners of the world (De Foliart 1989). An estimated 2000 insects species are consumed around the world and people don't just eat insect, they relish them as delicacies (Fromme, 2002). Moreover, in many parts of the world, insects (including grasshoppers and locusts, beetle larvae, caterpillars, brood of ants, wasps and bees, termites, cicadas, and various aquatic species) historically played, and continue to have, an important part as a normal component of the human diet. In ancient times, when humans first appeared on the earth, insects might have been important foods for them, because they had neither tools to hunt large animals, nor techniques for agriculture. Since then, entomophagy has continued up to the present time all over the world.

Keywords: Edible insects, Ethnic food, Nagaland, Diet.

Introduction

Hidden among the Himalayas, Nagaland has always evoked a sense of mysticism and awe, intensified by the remoteness of its geographical location. A vibrant hill state located in the extreme North-Eastern end of India. Nagaland offers a rich, incomparable traditional and cultural heritage. Nagaland with the total population of 19, 80, 602 (Statistical Handbook of Nagaland, 2011) has a geographical area of 16,579 km². This region falls within 8 mega biodiversity hotspot regions in the world. The warm tropical temperature climatic condition and ideal rainfall regime ensures abundant growth of variety of forest and rich biodiversity.

There are 16 recognized tribes and sub-tribes of Naga distributed in different parts of 11 district in Nagaland. They also have a sizeable population in Arunachal Pradesh, Assam, Manipur and eastern Myanmar. Edible insects constitute a very important food source in many developing good countries. They are good source of high content of proteins, fats, carbohydrates, minerals and vitamins (Ashiru 1988, De Foliart 1989, 1992). Insects play a key role in energy flow through the ecosystem, principally as herbivores but also as predators or parasites, which may themselves be consumed by higher-level insectivorous vertebrates. In turn, some of these vertebrates, notably freshwater fish and game birds, are eaten by humans. More than 200 genus and 70 families of insects are

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eaten up by people from different corners of the world (De Foliart 1989). An estimated 2000 insect species are consumed around the world and people don't just eat insect, they relish them as delicacies (Fromme, 2002). Moreover, in many parts of the world, insects (including grasshoppers and locusts, beetle larvae, caterpillars, brood of ants, wasps and bees, termites, cicadas, and various aquatic species) historically played, and continue to have, an important part as a normal component of the human diet. In ancient times, when humans first appeared on the earth, insects might have been important foods for them, because they had neither tools to hunt large animals, nor techniques for agriculture. Since then, entomophagy has continued up to the present time all over the world.

Some of the more popular insect and arachnids eaten around the world include crickets, cicadas, grasshoppers, ants, a variety of beetle grubs (such as mealworms), the larvae of the darkling beetle or rhinoceros beetle, a variety of species of caterpillar (such as bamboo worms, mopani worms, silkworms and waxworms), scorpions and tarantulas.

Entomophagy is sometimes defined broadly to include the practice of eating arthropods that are not insects, such as arachnids (tarantulas mainly) and myriapods (centipedes mainly). Pregnant and nursing women as well anemic people also eat caterpillar species high in protein, calcium and iron (Fromme, 2002). Edible insects are a natural renewable resource that provides food to many ethnic groups in many countries like Mexico, Latin America, Colombia, Venezuela, Zaire, Angola, Congo, South Africa, Zambia, Nigeria, Zimbabwe, Sudan, Kenya, Malawi, Uganda, Australia, North America, Japan, Thailand, Malaysia, Burma, Korea, China and India (Srivastava, 1996).

Aim of the Study

The study was carried out keeping in mind the following objectives:

1. Create awareness on the nutritional and medicinal benefits of insect consumption.
2. Bring to focus the insects that have been traditionally consumed by the Naga tribes of Nagaland.
3. Entomophagy and its Ecological significance.

Study Area

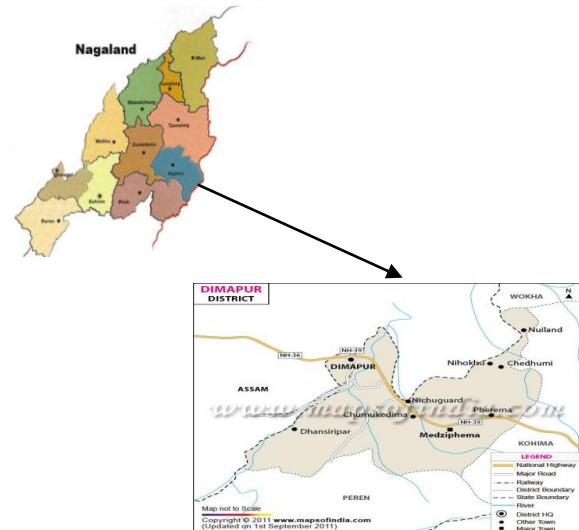
Nagaland, located in very Northeastern India, is a state that's just north of Myanmar and just south of China and Bhutan. There are 16 main tribes in Nagaland, each with similar yet unique traditions and practices. While food from each tribe overlaps, there are also certain dishes that are specially known from a certain tribe. In Nagaland many things are still done traditionally like hunting etc.

The source of the primary data was visit to local market of Dimapur district, which is the commercial city of Nagaland located at an altitude of 25.92°N-93.73° E. Local markets like Super-market also known as Wednesday market as the market open only on Wednesday upto certain period of time, personal interactions and interviews with local ladies where they sell varieties of insects including cicadas,

sting bug, silkworms, crickets, dragonflies, tawny mole crickets, red ants, frogs, grasshopper, snail, crabs etc are a delicacy food for the tribal people of Nagaland and also personal interactions and interviews with local ladies where they sell varieties of insects supplement their diet through insects where they sell varieties of insects supplement their diet through insects. The insects are collected from forests and paddy fields and sold in the market at a high price.

Study Area Map

Fig Map of dimapur district, showing the area of supermarket where the studied have been carried out.



Methodology

Surveys were conducted at the peak marketing hours between 7am-9am. At least 1-2hr was spent in the market during the data collection and vendors were questioned about the use of the edible insect items. A total of 12 days and 13-14 hrs were spent in the market place during six months of this field survey. A minimum of 20 individual women vendors in the market were interviewed regarding the local name of the bio-resources, their use, source, price and place from where they bought the items.

The age of these informants were above 20 years. Homemakers were included because they are responsible for collection, selling and preparation.

Data were collected through a questionnaire attached with colored photographs of the different insect species for easy identification. The informants were enquired about the insect species used as food/medicine, mode of consumption/utilization, form of preparations, life stages of insects consumed, association with other ingredients, culture related to insects, or any other uses etc. The insects are mostly collected from forests and paddy fields and sold in the market at a high price. The required information were collected from field survey, and tabulated and interpreted for the purpose. To aid in the investigation following approaches have been considered.

Observation

The field study helped in gathering valuable information on the consumption of several insects by the Nagas. Though the tribe has no much knowledge

about the nutritional aspects of insects, most of the population living in villages value them as good seasonal foods.

Rather than consuming insects as sources of nutrients, the Nagas regard insects as pastime food or appetizers. A good number of insect species are traditionally consumed among them. Many insects are taken as recreational food by all age groups. Entomophagy is more popular in the remote areas. The populations living in urban or sub-urban areas have no much knowledge about the edibility of several species of insects most probably because they have less opportunity to find them or they have begun regarding insects consumption as ancient.

Insects Popularly Consumed by the Nagas

Insects of many orders such as Coleoptera, Lepidoptera, Orthoptera, Odonata, Isoptera, Hymenoptera, etc. are harvested seasonally to add variety to their meals. Some of them are discussed below.

Winged Termites

Winged termites serve as one of the most delightful seasonal foods in the Naga community. They are found abundantly at the onset of monsoon after the first rains. They fly around light sources in the evening in great numbers. They are captured in water tub or bucket by misdirecting them with a source of light focused upon the water. Either a candle is lit above the water, or electric lamp or bulb is held above the tub to focus light. Within about 30 minutes or so, a plenty of them fall into the tub. They are then removed from the water, washed and heated in a frying pan until the wings are detached from their bodies. They are then removed from the pan and the wings are blown off by a hand-fan. Finally they are fried in limited oil. The dish is taken as a snack or served with the main meal. A handful of the dish is satisfactory for an individual as it has plenty of fats.

Red ant larvae

Eggs and larvae of red ants are a good source of protein and are lavishly favoured by the Nagas. People seasonally gorge themselves upon them in large quantities, bringing down several nests depending on how much is required for the meal. The nest of ants are found almost in all the trees especially broad leaves trees like mango tree. The branches bearing the nests of ants are cut off from the trees with the help of a sickle attached to a long bamboo rod that reaches the nests. The nests are then removed from the branches and dipped into a bucket of water and are torn inside the water. The leaves making the nests are removed from the bucket and then the eggs and the larva are separated from the adults. They are then fried and served with meal. Red ant nests are mostly found during the period of April-May.

Eggs and larvae of Bees

Eggs and larvae of a number of bees and wasps are taken as food by the tribes. Honey bees larvae are a good source of food among them. The adults are driven away by smoking their hives. The nests are then brought down and the eggs and larvae are taken out and fried. They are then either taken as

a snack or with the main meal, throughout the year.

On the other hand, pupae and larvae of bee and wasp are eaten as raw in some parts of north-east India where as queen termites are fed raw to weak children in some villages of Karnataka state. Similar forms of preparation were also described for giant water bugs and pentatomid bugs with Arunachal-Pradesh and Manipur.

Silkworm larvae

Larvae of silkworm, especially Eri, are one of the most sought-after foods by the Nagas tribes. Eri silkworm is cultivated by some villagers. Although production of cocoons is the main interest in rearing them, they also serve as a good source of food for the tribe. A plenty of larvae are eaten before they are allowed to reach the pupal stage to spin cocoons. They have a marketable value in terms of weight. They are first of all heated in a frying pan without oil, and then fried in oil.

June beetles

These Coleopterans are found perched on the branches or leaves of trees in forests. Three species of different sizes are consumed by the Nagas. The large type is found mainly feeding on mango leaves, while the small ones are found plenty on castor leaves. They are night feeders and voraciously feed upon leaves especially mango and castor. They are harmful pests of the plants they feed upon as they destroy almost all the leaves. They are directly hand-picked from trees or gathered with the help of smoke. The trees are smoked by burning hay torches under trees whereby they fall off the trees and collected beneath. The wings are removed and the feces are pressed out and fried. They are also taken as a snack or served with the main meal. They are also sometimes ground into paste. This serves as a good appetizer. These beetles are mostly found from March to May.

Belostoma

Belostoma are collected along with fish during fishing. They are found throughout the year. The wings and appendages are removed before cooking. These giant water bugs are either roasted over fire or fried in oil. They are either served whole or most preferably by making paste with chilly and some other spices. Belostoma, especially the females, are strongly flavoured which seems to give a good appetite during meals. They are never found in large numbers. However, a couple of them is sufficient for a meal as they are strongly scented and cannot be consumed in large amounts. They are used rather as an appetizer than as a source of nutrients. Some tribal also consumed the giant water bug in a different way in that they push dry rice inside the body and boiled then roasted.

Hydrophilus

These aquatic beetles are also caught during fishing. They are available throughout the year in rivers and marshes, most abundantly during summer. Their wings and appendages are removed and cooked. They are either fried separately or cooked along with fish.

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Beetle Grubs

Grubs of some beetles (*Datecera albefaciata*), living in old woods are also a good insect food among the Nagas. They are found buried inside the wood and are often found while chopping fire-woods. They are often found accidentally while

Grasshoppers

Various species of grasshoppers are taken as a pastime food by the Nagas, especially children. They may also be served with the main meal, but as they are difficult to be captured in large numbers it is rarely the case. They are simply burnt over the fire, dried and taken directly.

Crickets

Due to their large size, crickets can be a good source of food. They are mostly dug out of holes from the fields. They may also be driven out by pouring water into their holes. Crickets are often collected during the period from April to June. Fully grown crickets which have left their holes may also be collected when they are drawn to the homes at night by light sources. Their wings appendages and faeces are removed before cooking. They may be either roasted or fried, and then ground to paste and served with the main meal or eat whole. Crickets are one of the good seasonal foods among the Nagas. They are found mostly during March-August.

Spiders

One of the most favourable food of the Nagas. The local people collected them from wild forest or house garden. They are seasonal insect so are rear to get it every month. Usually found during

chopping wood, and become a rare food. However, if the presence of a huge number of them is suspected somewhere, they are deliberately hunted. These grubs grow over 4 cm. and serve as a heavy dish when found in large quantities.

the month of Aug-Nov and this spider species are collected using piece of stick by gently pulling on the web during twisting the web with the help of the stick. The web will eventually pull all of the way out with the spider contained in the small bulb formed at the end of its web. And putting the web in a container and gently cut the bulb open. Mostly prefer to eat roasted or fried.

Results and Discussion

Entomophagy is an age-old practice that continues to this day in many parts of the world. Possibly more than 2,000 species of insects, mostly forest-based and often classified as pests, have been serving as human food for subsistence and/or in commerce. Science increasingly provides data corroborating the nutritional and health benefits of entomophagy, suggesting broader acceptance of this practice, while giving due consideration to certain risk factors.

Nutritional Value of Various Insects Per 100 Grams

Data collected from The Food Insects Newsletter, July 1996 (Vol. 9, No. 2, ed. by Florence V. Dunkel, Montana State University) and Bugs In the System, by May Berenbaum.

Insect Name	Protein (g)	Fat (g)	Carbohydrate(g)	Calcium (mg)	Iron(mg)
Giant Water Beetle	19.8	8.3	2.1	43.5	13.6
Red Ant	13.9	3.5	2.9	47.8	5.7
Silk Worm Pupae	9.6	5.6	2.3	41.7	1.8
Dung Beetle	17.2	4.3	.2	30.9	7.7
Cricket	12.9	5.5	5.1	75.8	9.5
Grasshopper	20.6	6.1	3.9	35.2	5.0
Grasshopper	14.3	3.3	2.2	27.5	3.0
June Beetle	13.4	1.4	2.9	22.6	6.0
Caterpillar	28.2	N/A	N/A	N/A	35.5
Caterpillar	9.7	N/A	N/A	N/A	1.9
Termite	14.2	N/A	N/A	N/A	35.5
Weevil	6.7	N/A	N/A	N/A	13.1
Beef (Lean Ground)	27.4	N/A	N/A	N/A	3.5
Fish (Broiled Cod)	28.5	N/A	N/A	N/A	1.0

Commonly Found Edible Insects and Others Bio-Resources Consumed by the Naga Community, Showing The Stage and Parts Eaten

SI No	Common Name	Local Name	Scientific Name	Stage Eaten	Parts Eaten
1	Giant water beetle	Tsuleplo(Ao)	Belostoma sp.	Adult	Whole body except wings and legs
2	Red ant	Lal chimti (Nagamese)	Formica indica	Larva	Whole body
3	Silkworm	Eri puka (Nagamese)	Samia cynthia ricini	Larva	Whole body
4	Field Cricket	Khongbai (Kuki)	Ocheta domestica	Adult	Whole body except wings and legs
5	Grasshopper	Authkha(sumi)	Nymph, Adult	Whole body except wings and legs
6	June beetles	Ghas puka (Nagamese)	Phyllophaga portoricensis	Adult	Whole body except wings and legs

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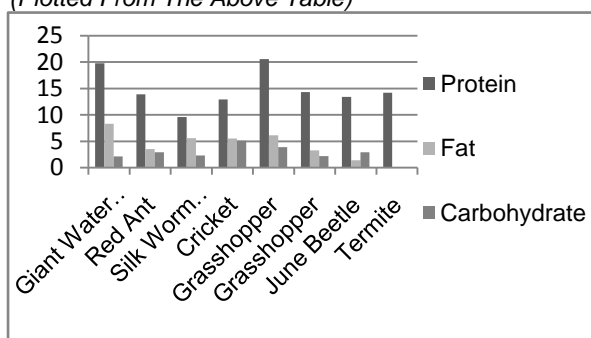
7	Winged Termite	Along(konyak) Phulim(Kuki)	Microtermis sp.	Adult	Whole body except wings
8	Longhorn beetle	Tsukha (Ao)	Datecera albefaciata	Larva	Whole body
9	Diving beetle	Tsukha (Ao)	Hydrophilus indicus	Adult	Whole body except wings and legs
10	Spiders	Seilmon(Kuki)	Adult	Whole body except heads and leg
11	Wood worm	Thinglung (Kuki)	Beetle grub	Larva	Whole body
12	Honey bee	Khoi (kuki)	Apis indica	Pupa,honey, Larva	Whole body
13	Bamboo borer	Bamboo puka (Nagamese)	Omphisa	Larva	Whole body
14	Snails	Chokibo(sumi) Twilung(kuki)	Pila sp	Adult	Whole body except the shell
15	Frogs	Aachiu (sumi)	Rana sp	Young , adult	Whole body except inside organs
16	Crab	Ai (Kuki)	Young, adult	Whole body
17	Prawn	Kaikong (Kuki)	Palaemon sp	Young, adult	Whole body

The above investigation documented a list of more than 13 insect species belonging to the different families as well others bio-resources consumed seasonally or yearly which is no means exhaustive. The scientific investigation on its chemical contents will further provide reliable source of nutrition to the people for better health, because of their nutritive value and ubiquitous presence, insects present a potential sustainable food source for human (Kato *et.al.*, 2009). The eating of insects (entomophagy) are an inexpensive substitute for meat in many developing countries (Lyon, 1996). Detailed investigation on their rearing prospect in traditional way will prove reward and traditional system of rearing and cultivation will be beneficial for natural conservation of insect fauna.

Fig. 5.1

Graphical Representation of Nutritive Value of Insects Consumed by the Nagas and Some Ethnic Group of Different State In India.

(Plotted From The Above Table)



Though the Nagas do not have much knowledge on the value of insect consumption, they are very enthusiastic about feeding on them as part of their meals. Insects are joyfully served by them. They do not miss the opportunity to capture or collect them seasonally. For example, the nests of red ants are often harvested in large numbers during the period of April to June. The sight of winged termites at the onset of monsoon is a signal for them to indulge in collecting them in large quantities.

The nutritive parameters of a good number of insects have already been estimated by the

scientific community. The data pertaining to most of the insects consumed in the Naga community are already available, whereby a conclusion can be drawn that the Nagas have traditionally been benefiting a lot from entomophagy in terms of nutrition. The nutritive value of red ants, crickets, June beetles, termites and grasshoppers are indeed high (from the above table).

Management of Insects as Food for Humans

Some insects such as honey bees and silkworms are reared in many homes among the Nagas for the production of honey and cocoons respectively. Incidentally, the larvae of these insects are nutritious by products of their objective purposes. People of the hill districts in Nagaland considered the curry preparation of bees as the top most delicious item among their dishes. Aquatic beetles are also popular in Nagaland and other parts of north east India. The mode of harvest of edible insect showed that different collection techniques was found to be employed depending on the prevailing situations of the insect's habit and habited at a particular period.

The availability of edible insect is unpredictable, both in time and location. Most edible insects are harvested from wild. Other insects such as edible beetles, wild bees, etc. are exploited to a large extent from the forest by the Nagas for consumption.

Benefits of Insect Consumption

Insects offer particular benefits to those who want to reduce their environmental footprint, because they are exceptionally efficient in converting what they eat into tissue that can be consumed by others – about twice as efficient as chickens and pigs, and more than five times as efficient as beef cattle. Factoring in their astounding reproduction rates and fecundity, the actual food conversion efficiency of insects may be 20 times that of cattle. Moreover, insects feed on a far wider range of plants than conventional livestock.

Insect consumption may also help to reduce the adverse environmental impacts of livestock production as insect rearing requires far less space and generates less pollution. As a food source, insects are highly nutritious. Many insect species contain as much – or more – protein as meat or fish. Some insects, especially in the larval stage, are also

rich in fat and most insects contain significant percentages of amino acids and essential vitamins and minerals.

Major Groups of Edible Insects

Globally, the most common insects consumed are beetles (Coleoptera) (31 percent). This is not surprising given that the group contains about 40 percent of all known insect species. The consumption of caterpillars (Lepidoptera), especially popular in sub-Saharan Africa, is estimated at 18 percent. Bees, wasps and ants (Hymenoptera) come in third at 14 percent (these insects are especially common in Latin America). Following these are grasshoppers, locusts and crickets (Orthoptera) (13 percent); cicadas, leafhoppers, planthoppers, scale insects and true bugs (Hemiptera) (10 percent); termites (Isoptera) (3 percent); dragonflies (Odonata) (3 percent); flies (Diptera) (2 percent); and other orders (5 percent). Lepidoptera are consumed almost entirely as caterpillars and Hymenoptera are consumed mostly in their larval or pupal stages. Both adults and larvae of the Coleoptera order are eaten, while the Orthoptera, Homoptera, Isoptera and Hemiptera orders are mostly eaten in the mature stage (Cerritos, 2009).

Entomophagy and Human Health

As insects are high in mono- and poly-unsaturated fatty acids, intake of insect products instead of conventional livestock products may have positive health effects. Iron deficiency is the world's most common nutritional disorder, according to the World Health Organisation (WHO). This condition not only occurs in developing countries but also in Western societies, e.g. in Sweden, 45% of adolescent girls are at risk of iron deficiency (Sjöberg and Hulthén, 2015). Many insects have a high iron content (Bukkens, 1997; Bukkens, 2005; Oonincx *et al.*, 2011), even higher than red meat (FAO, 2013), and entomophagy could therefore be recommended from that perspective. If red meat consumption is reduced in the future, as recommended by the Swedish National Food Administration (Livsmedelsverket, 2015), iron deficiency could become even more common than it is now unless appropriate substitutes are used. Chitin is a main component of the exoskeleton in insects and consists of a polymer of N-acetyl-glucosamine. Chitinase (the enzyme that breaks down chitin) has been found in human gastric juices (Paoletti *et al.*, 2007), but it is not clear to what extent chitin is actually digested by humans. The effects of chitin intake seem to be complex and both negative and positive impacts on the immune system have been documented (FAO, 2013). The effect of chitin consumption in humans needs further investigation. It has been observed that consumption of locusts and grasshoppers without removing their legs can cause intestinal constipation and therefore removal of legs, and perhaps also wings, prior to consumption is recommended (FAO, 2013). A preliminary study also indicates that patients allergic to house dust mites and crustaceans may be at risk when consuming mealworm protein (Broekman *et al.*, 2014). As with all nutrient-rich food, there is a risk of

contamination and growth of microbes during processing and storage of insect products. This may, of course, adversely affect product quality, but it may also cause food-borne illness.

Conclusion

Nagaland has rich diversity not only of their food but also has various methods of food preparation. It has exotic varieties of foods with high nutritional values. The healthy lifestyle and food is reflected in their skin, hair texture and physique. The endemic herbs of Nagaland have significant medicinal value and they are extensively used by people in their houses to cure diseases. Nagaland is full of secrets with respect to herbs, cuisine and cooking methods therefore aptly known as the Flacon Capital of the World and provides a wide scope of research in its floral diversity. The possibility of finding cures to some rare diseases is much likely in the wild beauty of this rich and unexplored state.

Entomophagy is an age-old practice that continues to this day in many parts of the world. Possibly more than 2 000 species of insects, mostly forest-based and often classified as pests, have been serving as human food for subsistence and/or in commerce. Science increasingly provides data corroborating the nutritional and health benefits of entomophagy, suggesting broader acceptance of this practice, while giving due consideration to certain risk factors. At the same time that acceptance of entomophagy seems to be on the rise and demand is increasing, the sustainability of wild insect stock is in question. To enhance food security and potentially generate extra income, edible insects can be managed at various levels of intensity, from mini game *in situ* to more intensive management of semi- or fully domesticated mini livestock *ex situ*. In natural or near-natural forests still exist or can be restored, certain insects can be treated like other game animals. So, the country like India also goes for the conservation and commercialization of these insects.

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